



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
OFFICE OF PREVENTION, PESTICIDES, AND TOXIC SUBSTANCES  
WASHINGTON, D.C. 20460

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**MEMORANDUM**

Subject: **Acephate** - Sensitivity Analysis For Turf Risk Assessment, [Case #819371, PC Code 103301, DP Barcode D276433]

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The purpose of this memo is to provide a sensitivity analysis of the revised turf risk assessment for acephate to demonstrate how changes in key input parameters affect overall risk estimates. The latest assessment (D270363) was completed on February 13, 2001 (Author: Jeff Dawson). In that assessment, risks from acephate and methamidophos residues were considered only on the day of application. This analysis also considers residue dissipation over time based on the dissipation data contained in MRID 448064-01.

## 1. Results of the February 13, 2001 Agency Assessment (D270363)

MOEs were calculated for each exposure pathway that are routinely considered in Agency assessments (i.e., dermal, hand- and object-to-mouth, soil ingestion, and aggregate). Exposure to acephate and methamidophos residues was considered based on residues observed on the day of application in a turf transferable residue study (MRID 448064-01). These data indicated that 0.38 percent of the acephate applied was represented by methamidophos and an average transferability for acephate of about 0.6 percent. The inputs used for the calculations represented the latest approaches for residential risk assessment being used at that time. [Note: Additional revisions have occurred even since that time which are discussed below.] Major modifications that were made in the February document include the use of a saliva extraction factor (50%) and use of a 5 percent transferability factor for hand-to-mouth calculations instead of the measured TTR levels from MRID 448064-01. All scenarios considered by for toddlers by the Agency are of concern. The scenarios considered for adults were not of concern.

The MOEs for that assessment are summarized below in Table 1 for toddlers for the day of application (values presented are for after application 2 in TTR study which has also been used for sensitivity analysis). Toddler risks are the key concern for acephate use on turf, so the Agency has focused on these for the purposes of this sensitivity analysis.

Table 1: Summary of MOEs From Feb 13, 2001 Turf Risk Assessment For Acephate (D270363)					
Chemical	MOEs				
	Dermal	Hand-mouth	Object-mouth	Soil Ingestion	Aggregate
Acephate	357	9.6	38.2	2850	7.5
Methamidophos	1457	1522	6088	454 *	270

\* There appears to be a math error in this value (i.e., MOE is too low). See sensitivity analysis below for corrected values.

## 2. Inputs Used For Sensitivity Analysis Of Acephate Turf Use

The sensitivity analysis for acephate use on turf addresses the calculations for each of the exposure pathways that are routinely considered in the Agency's standard approach for turf chemicals (i.e., dermal, hand-to-mouth, object-to-mouth, and soil ingestion). Each input is described below as well as the range of inputs considered. In the February 2001 assessment, the Agency only considered the day of application but in this assessment the residue dissipation kinetics were determined for the TTR data contained in MRID 448064-01. This analysis was completed with a standard pseudo-first order approach which is commonly used by the Agency. The data and analysis are presented in Appendix A of this document.

The Agency has developed a number of background documents that describe how the Agency completes residential risk assessments. These documents were referenced extensively in the development of this memo. They include:

- ***Series 875, Residential and Residential Exposure Test Guidelines: Group B - Postapplication Exposure Monitoring Test Guidelines (V 5.4, Feb. 1998)*** This document provides general risk assessment guidance and criteria for analysis of residue dissipation data.
- ***Standard Operating Procedures For Residential Exposure Assessment (Dec. 1997)*** This document provides the overarching guidance for developing residential risk assessments including scenario development, algorithms, and values for inputs.
- ***Science Advisory Council For Exposure Policy 12 (Feb. 2001): Recommended Revisions To The Standard Operating Procedures (SOPs) For Residential Exposure Assessment*** This document provides additional, revised guidance for completing residential exposure assessments.
- ***Overview of Issues Related To The Standard Operating Procedures For Residential Exposure Assessment (August 1999 Presentation To The FIFRA SAP)*** This document provides rationale for Agency changes in SOPs. Companion animal approach included in document used for risk assessment.

## 2.1 Dermal Exposures On Turf

Dermal exposures were calculated using turf transferable residue levels for acephate or methamidophos using the following equation.

$$DE_{(t)} \text{ (mg/day)} = (TTR_{(t)} \text{ (F g/cm}^2\text{)} \times TC \text{ (cm}^2\text{/hr)} \times \text{Hr/Day})/1000 \text{ (F g/mg)}$$

Where:

<b>DE(t)</b>	=	Daily exposure or amount deposited on the surface of the skin at time (t) attributable for activity in a previously treated area, also referred to as potential dose (mg ai/day);
<b>TTR(t)</b>	=	Turf transferable residue at time (t) where the longest duration is dictated by the decay time observed in the studies (F g/cm <sup>2</sup> );
<b>TC</b>	=	Transfer Coefficient (cm <sup>2</sup> /hour); and
<b>Hr/day</b>	=	Exposure duration meant to represent a typical day (hours).

Determining how changes in each input affects the calculated risk is the point of conducting a sensitivity analysis. The source of each input parameter found in the equation above is discussed below as well as the range of values associated with each.

### 2.1.1 Turf Transferable Residues (TTR)

Current Agency policy (Exposure SAC Policy 12: *Recommended Revisions To The Standard Operating Procedures (SOPs) For Residential Exposure Assessment*) indicates that measured TTR values on the day of application are supposed to be used to calculate dermal exposures if the transferability (i.e., measured TTR divided by application rate) is 1 percent or greater of the application rate. If TTR values are less than 1 percent of the rate a value of 5 percent transferability is to be used to calculate TTR values for the day of application. In all cases, the slopes of dissipation curves (i.e., actual dissipation rates) are to be used to calculate how residues decline over time. A study was completed on turf for acephate that used the Outdoor Residential Exposure Task Force Roller (ORETF) method. The February 2001 acephate assessment is based on this actual TTR data even though the transferability is only 0.51 percent because the Agency policy was not altered until after the assessment was already complete. This transferability is consistent with data from other chemicals based on the ORETF method where values for many are noted in the <0.10 to 0.50 percent range.

The Agency's policy stems from the fact that the Jazzercise studies used to develop the dermal transfer coefficients for children playing on turf were not generated using the ORETF TTR sampling method which is predominantly in use today. In fact, the Jazzercise transfer coefficient database used by the Agency to develop its current dermal transfer coefficients have TTR transferabilities of 1 to 5 percent. The different TTR sampling methods have different sensitivities associated with them, in other words the ORETF roller technique seems to pick up less material than the methods used in the Jazzercise studies meaning that ORETF roller data (which was used for the acephate study) could underestimate dermal exposures when coupled with the Jazzercise transfer coefficient.

To provide an estimate of how changes in this factor would impact the results of the acephate risk assessment, the Agency used the following inputs for the sensitivity analysis.

Table 2: Range of Turf Transferability Inputs For Dermal Exposure Considered in Acephate Sensitivity Analysis			
Value	0.51%	1%	5%
Descriptor	Measured TTR, used for Feb 2001 prior to current policy	Delimiter for use of measured TTRs	Value used if TTR data not available or <1%

### 2.1.2 Transfer Coefficient (TC)

The Agency did not deviate from the TC used in the February 2001 assessment for toddlers (i.e., 5200 cm<sup>2</sup>/hour) based on the guidance presented to the FIFRA SAP in 1999 concerning how this value was derived.

### 2.1.3 Hours Per Day (Hr/day)

The Agency did not deviate from the hourly estimates used in the February 2001 assessment for toddlers (i.e., 2 hours/day playing on grass) based on Tsang and Klepeis 1996 as described in the Agency's *Exposure Factors Handbook* (i.e., this is a 75<sup>th</sup> %tile based on a truncated distribution). It should also be kept in mind that the Agency's *Exposure Factors Handbook* reports 95<sup>th</sup> % tile values for playing outdoors as 3.5 hours, for time spent on school grounds/playgrounds as 2.9 hours, and for time spent at home in the yard or other areas outside the home as 5.75 hours/day for children 1 to 4 years old. Each of these activities may also potentially include contact with treated turf.

## 2.2 Hand-to-mouth Exposures On Turf

Hand-to-mouth exposures were calculated using turf transferable residue levels for acephate or methamidophos using the following equation.

$$D = (TTR) \left( \frac{SE}{100} \right) (SA) (Freq) (Hr) (1mg/1000Fg)$$

where:

D	=	dose from hand-to-mouth activity (mg/day);
TTR	=	Turf Transferable Residue where dissipation is based on TTR study and the 0-day value is based on the 5% initial transferability factor (F g/cm <sup>2</sup> );
SE	=	saliva extraction factor (%);
SA	=	surface area of the hands (cm <sup>2</sup> );
Freq	=	frequency of hand-to-mouth events (events/hour); and
Hr	=	exposure duration (hours).

Determining how changes in each input affects the calculated risk is the point of conducting a sensitivity analysis. The source of each input parameter found in the equation above is discussed below as well as the range of values associated with each.

### 2.2.1 Turf Transferable Residues (TTR)

Current Agency policy (Exposure SAC Policy 12: *Recommended Revisions To The Standard Operating Procedures (SOPs) For Residential Exposure Assessment*) indicates that measured TTR values are not to be used for risk assessment purposes when calculating hand-to-mouth exposures because the current methods being used to collect them (i.e., predominantly, the ORETF roller) are not designed to gather residues similar to those that would be picked up by a child with wet, sticky hands. In lieu of monitoring data appropriate for wet, sticky hands the Agency uses a factor of 5% transferability to complete all hand-to-mouth assessments (i.e., 5% of the application rate is considered to be available).

The Agency's policy stems from a study completed by its Office of Research and Development in which a range of transferability was noted in volunteers who wetted their hands with their own saliva and then pressed it on treated turf in a controlled manner (Clothier, 2000). It should be noted that wet hands picked up 2 to 3 times more residues than dry hands in this study. The 5 percent value that the Agency uses for this factor is protective based on the range of transferability seen in the study of 0.16 to 4.2 percent.

To provide an estimate of how changes in this factor would impact the results of the acephate risk assessment, the Agency used the following inputs for the sensitivity analysis.

Table 3: Range of Turf Transferability Inputs For Hand-to-Mouth Exposure Considered in Acephate Sensitivity Analysis				
Value	0.16%	1%	2.5%	5%
Descriptor	Measured value for chlorpyrifos in Clothier 2000	Mid-range estimate	Mid-range estimate	Value specified in Agency SOPs

### 2.2.2 Saliva Extraction (SE)

The Agency did not deviate from the SE used in the February 2001 assessment for toddlers (i.e., 50%) based on the guidance presented to the FIFRA SAP in 1999 concerning how this value was derived.

### 2.2.3 Hand Surface Area (SA)

Current Agency policy (Exposure SAC Policy 12: *Recommended Revisions To The Standard Operating Procedures (SOPs) For Residential Exposure Assessment*) indicates that 20 cm<sup>2</sup> of skin surface area is contacted orally each time a child puts their hands in their mouth. This surface area represents the palm side of 3 fingers for a toddler.

The Agency's policy stems from the 1999 FIFRA SAP meeting where values representing parts of the hand (i.e., ~20 cm<sup>2</sup> or palmar surface of 3 fingers) up to the surface of the entire hand (i.e., ~120 cm<sup>2</sup> in some cases) were discussed. The Agency decided upon a lower value because it believes that 3 fingers better represents what a child might routinely put in their mouth than actually placing their entire hand in their mouths every time. This issue was also discussed at the 1999 FIFRA SAP meeting (i.e., John Kissel raised the issue of defining what is a hand-to-mouth event).

To provide an estimate of how changes in this factor would impact the results of the acephate risk assessment, the Agency used the following inputs for the sensitivity analysis.

Table 4: Hand Surface Area Inputs For Hand-to-Mouth Exposure Considered in Acephate Sensitivity Analysis				
Value	1cm <sup>2</sup>	4cm <sup>2</sup>	10cm <sup>2</sup>	20cm <sup>2</sup>
Descriptor	Low range value, ~ a fingertip	mid range value, <1 finger	mid range value, <2 fingers	Value specified in Agency SOPs,

#### 2.2.4 Frequency of Hand-to-mouth Behavior (Freq)

Current Agency policy (Exposure SAC Policy 12: *Recommended Revisions To The Standard Operating Procedures (SOPs) For Residential Exposure Assessment*) considers that a child might put their hands in their mouth 20 times per hour for short-term exposures and 9.5 times per hour for more extended exposure periods (i.e., intermediate-term exposures).

The Agency's policy stems from data presented by Reed et al (1999) that were also discussed at the FIFRA SAP where a range of 0 to 70 events per hour were noted. The value used by the Agency is the 90<sup>th</sup> %tile of these data for short-term assessments (i.e., 20 times per hour) while the mean of 9.5 events per hour is used for intermediate-term exposures.

To provide an estimate of how changes in this factor would impact the results of the acephate risk assessment, the Agency used the following inputs for the sensitivity analysis.

Table 5: Frequency Inputs For Hand-to-Mouth Exposure Considered in Acephate Sensitivity Analysis				
Value	1 time/hour	4 times/hour	10 times/hour	20 times/hour
Descriptor	Low range value	mid range value	mid range value (9.5 also presented per intermediate- term SOPs)	Value specified in Agency SOPs for short-term exposures

#### 2.2.5 Hours Per Day (Hr/day)

The Agency did not deviate from the hours/day used in the February 2001 assessment for toddlers (i.e., 2 hours). See 2.1.3 above.

### 2.3 Object-to-mouth Exposures On Turf

Object-to-mouth exposures were calculated using turf transferable residue levels for acephate or methamidophos using the following equation.

$$D' = (TTR \cdot IgR \cdot (1mg/1000Fg))$$

where:

D	=	dose from mouthing activity (mg/day);
TTR	=	Turf Transferable Residue where dissipation is based on TTR study and the 0-day value is based on the 20% initial transferability factor (F g/cm <sup>2</sup> ); and
IgR	=	ingestion rate for mouthing of grass per day (cm <sup>2</sup> /day).

### 2.3.1 Turf Transferable Residues (TTR)

Current Agency policy (Exposure SAC Policy 12: *Recommended Revisions To The Standard Operating Procedures (SOPs) For Residential Exposure Assessment*) indicates that measured TTR values are not to be used for risk assessment purposes when calculating object-to-mouth exposures because the current methods being used to collect them (i.e., predominantly, the ORETF roller) are not designed to gather residues similar to those that would be picked up when a child teethes a handful of grass. In lieu of monitoring data appropriate for this behavior, the Agency uses a factor of 20% transferability to complete all object-to-mouth assessments (i.e., 20% of the application rate is considered to be available).

The Agency's policy stems from the similarity of this behavior to the kind of transferability that might be seen in the Iwata method for collecting dislodgeable foliar residues (DFRs). The Agency expects that a child teething would involve mechanical removal of residues (e.g., tongue movement) and natural saliva that would be similar to the use of an aqueous surfactant solution and mechanical agitation in DFR sampling. The transferability for acephate DFRs seen in beans, tobacco, and roses averages 18 percent or so of the application rate. Cauliflower data values were much lower compared to the others.

To provide an estimate of how changes in this factor would impact the results of the acephate risk assessment, the Agency used the following inputs for the sensitivity analysis.

Table 6: Range of Turf Transferability Inputs For Object-to-Mouth Exposure Considered in Acephate Sensitivity Analysis				
Value	1%	4%	10%	20%
Descriptor	Low-range estimate	Mid-range estimate	Mid-range estimate	Value specified in Agency SOPs

### 2.3.2 Ingestion Rate (Igr)

The Agency did not deviate from the ingestion rate used in the February 2001 assessment for toddlers (i.e., 25cm<sup>2</sup> handful of turf mouthed one time).



## 2.4 Soil Ingestion Exposures On Turf

Exposures from soil ingestion were calculated for acephate or methamidophos using the following equation.

$$D = (SR \times IGR \times (1E-6 \text{ g/l Fg}))$$

where:

D	=	dose from soil ingestion activity (mg/day);
SR	=	Soil Residue where dissipation is based on TTR study and the 0-day value is based on the application rate, 1 cm depth of surface soil, and the density of soil (Fg/cm <sup>3</sup> ); and
IGR	=	ingestion rate for daily soil ingestion (mg/day).

No input values were altered in this aspect of the risk assessment in the sensitivity analysis. Therefore, a discussion of each parameter is not included below. Additionally, it should be noted that soil ingestion is a minor overall contributor to risks from turf chemicals.

## 3.0 Results of the Sensitivity Analysis

The Agency used several combinations of input variables to complete the sensitivity analysis for acephate use on turf. Appendix B contains the worksheets that were completed in this analysis. The five variables that were analyzed (i.e., transferable residues for all dermal and oral pathways, hand-to-mouth frequency, and hand surface area) are noted in the top of each sheet while the variables that were held constant are presented in the first page of Appendix B. The results of the sensitivity analysis for just the day of application are presented in Table 7 along with the different combinations of inputs used (in parenthesis). Residue decline was also considered and these results are included in the worksheets (Appendix B). Results for current SOP policies and the Agency's February 2001 assessment are highlighted. It is clear that aggregate MOEs exceed 100 only when the input variables are all at the lowest ranges. If central tendency inputs are used or the upper percentile (i.e., screening) values included in the SOPs it is also clear that MOEs are less than 100. Methamidophos residues were also considered but MOEs exceeded the 300 (i.e., were 669) on the day of application using current SOP inputs so no further analysis was completed (see last worksheet in Appendix B).

Table 7: Summary of Sensitivity Analysis For Acephate Turf Risk Assessment (Day of Application Residues)					
MOEs					Descriptor
Dermal	Hand-mouth	Object-mouth	Soil Ingestion	Aggregate	
357 (Meas. TTR)	9.5 (5% TTR, 20x/hr, 20cm <sup>2</sup> )	38.2 (20% TTR)	2850	7.5	<b>February 2001 Agency Results</b>
357 (Meas. TTR)	76.4 (2.5% TTR, 10x/hr, 10cm <sup>2</sup> )	76.4 (10% TTR)	2850	34	
357 (Meas. TTR)	1194 (1% TTR, 4x/hr, 4cm <sup>2</sup> )	191 (4% TTR)	2850	108	
357 (Meas. TTR)	19099 (1% TTR, 1x/hr, 1cm <sup>2</sup> )	764 (1% TTR)	2850	222	
357 (Meas. TTR)	119366 (0.16% TTR, 1x/hr, 1cm <sup>2</sup> )	764 (1% TTR)	2850	224	Lowest inputs for all
357 (Meas. TTR)	298 (0.16% TTR, 20x/hr, 20cm <sup>2</sup> )	38.2 (20% TTR)	2850	31	Low input for HTM %trans
357 (Meas. TTR)	628 (0.16% TTR, 9.5x/hr, 20cm <sup>2</sup> )	38.2 (20% TTR)	2850	32	Low input for HTM %trans and mean for frequency
183 (1% TTR)	9.5 (5% TTR, 20x/hr, 20cm <sup>2</sup> )	38 (20% TTR)	2850	7.3	
183 (1% TTR)	76 (2.5% TTR, 10x/hr, 10cm <sup>2</sup> )	76 (10% TTR)	2850	31	
183 (1% TTR)	1194 (1% TTR, 4x/hr, 4cm <sup>2</sup> )	191 (4% TTR)	2850	84	
183 (1% TTR)	19099 (1% TTR, 1x/hr, 1cm <sup>2</sup> )	764 (1% TTR)	2850	140	
183 (1% TTR)	119366 (0.16% TTR, 1x/hr, 1cm <sup>2</sup> )	764 (1% TTR)	2850	141	Lowest inputs for all but dermal TTR
183 (1% TTR)	298 (0.16% TTR, 20x/hr, 20cm <sup>2</sup> )	38 (20% TTR)	2850	28	Low input for HTM %trans
183 (1% TTR)	628 (0.16% TTR, 9.5x/hr, 20cm <sup>2</sup> )	38 (20% TTR)	2850	30	Low input for HTM %trans and mean for frequency
37 (5% TTR)	9.5 (5% TTR, 20x/hr, 20cm <sup>2</sup> )	38 (20% TTR)	2850	6.3	<b>Reflects Current Residential SOPs</b>
37 (5% TTR)	76 (2.5% TTR, 10x/hr, 10cm <sup>2</sup> )	76 (10% TTR)	2850	19	
37 (5% TTR)	1194 (1% TTR, 4x/hr, 4cm <sup>2</sup> )	191 (4% TTR)	2850	30	
37 (5% TTR)	19098 (1% TTR, 1x/hr, 1cm <sup>2</sup> )	764 (1% TTR)	2850	35	
37 (5% TTR)	119366 (0.16% TTR, 1x/hr, 1cm <sup>2</sup> )	764 (1% TTR)	2850	35	Lowest inputs for all but dermal TTR
37 (5% TTR)	298 (0.16% TTR, 20x/hr, 20cm <sup>2</sup> )	38 (20% TTR)	2850	18	Low input for HTM %trans
38 (5% TTR)	628 (0.16% TTR, 9.5x/hr, 20cm <sup>2</sup> )	38 (20% TTR)	2850	18	Low input for HTM %trans and mean for frequency

# **Appendix A: D276433**

## **TTR Data Analysis**

## **Appendix B: D276433**

### **Sensitivity Analysis Results**